boys—taking her part of their shared oranges and Twinkies, sometimes sitting as an accepted member on the boys' side of the class or cafeteria. But Jessie also claims Kathryn, the most popular girl in the class, as her best friend and joins in whispering with three other girls, "Just us four will play jump rope." Jessie's behavior, like that of some other boys and girls, neutralizes the gender divide though it does not earn her the label of "tomboy"—a term these children rarely use (although many still use the word "sissy" to insult boys and devalue girls).

Thorne also finds that in some groups, whether working on class projects or playing handball, girls and boys intermingle. Sometimes interaction emphasizes opposition: Groups of boys and girls chase each other, squealing "help save me from the girls" and "let's get that boy," or they ritually express antagonism and power (usually boys') when their touch transfers cooties (which girls can give to boys and to girls but boys can only give to girls). But interaction also sometimes dissolves difference, as boys become less aware that they are boys and girls less aware that they are girls.

Finding so much variation, Thorne rejects the commonly cited "ultimate" explanations for gender segregation. She disclaims the psychoanalytic version (most prominent in Nancy Chodorow's or Myrna Dinnerstein's theories that boys separate from and devalue things feminine in order to gain separation from their mothers) and the cognitive version (in which a number of acclaimed scholars have argued that the growing awareness that one is a boy or a girl consolidates around age two, setting in place identification with, and desire to be with, others of "one's own kind"). Thorne suggests, instead, that we need to understand the fluctuating significance of gender. In what social situations are boys and girls likely to choose to be together or apart?

By raising and answering this question, Thorne rejects the standard conception of childhood in which children are viewed in terms of development or as recipients of socialization. Even recent writers who insist that children participate in their own socialization wind up treating children as incomplete, on the way to becoming something, "acted upon more than acting" (p. 3). In *Gender Play*, children are not just the next generation's adults. They are not simply preparing for life. They are living. Groups of kids—in forming lines and choosing seats, teasing and gossiping—are creative, sometimes confirming and sometimes rejecting, sometimes even mocking, adults' insistence that boys and girls are "just different."

Moreover, Thorne offers an explanation of why most research and social commentary on boys and girls report only gender difference. It is, she argues, a result of a scientific model that emphasizes statistical difference. It is, in part, because difference is what researchers, with a vision and language of the "opposite sex," are willing or able to perceive. And it is also in part, Thorne argues, a result of the key informants often used in ethnographic research. For example, studying boys' play, ethnographers tend to rely on those popular athletes who are assertive, in both talk and action. These boys' flamboyant masculinity is then falsely generalized to all boys.

Thorne shows that the organization and meaning of gender shift from circumstance to circumstance and age to age. She argues (although she has few data to support it) that schools—because of their formal age grading, their crowded and public character, and the presence of adult evaluation and power—are likely to have more gender segregation than other settings, such as neighborhoods or families. But even within schools, there are occasions when gender matters less. Sometimes a resource (like popularity) allows girls to join boys or, less frequently, boys to join girls—in earnest, without taunts or disruption. Sometimes ethnicity or race becomes the source of group alliance or individual exception, making gender less important. In small instructional groups, gender also tends to recede in importance as particular skills—such as reading—become the focus. As Thorne details, teachers can use her findings about the fluctuation of gender in children's play to encourage cooperation between girls and boys—by organizing students into small, heterogenous groups, relying on skill rather than gender to organize activities, or using terms of address like "students" or "class" rather than "boys and girls."

Entering the fifth and sixth grades, some children, with the fully developed bodies of teens, continue to play with jump ropes and toy cars. For others, still looking like children, "goin' with" becomes the central activity, as they divide up into shifting girl-boy pairs. Entering the romantic (hetero)sexuality on which girls' (but not boys') social position increasingly depends, they learn to put on makeup, try new modes of dress, and move their bodies in sexualized ways. Childhood ends. But in taking kids and their play seriously, Thorne's penetrating and subtle analysis makes it much harder to see gender or age grades as ubiquitous or natural divides.

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Vignettes: Chaos

The term "chaos" entered science in an unlikely way. The first recorded observation of an amoeba was by Rîsel von Rosenhof in 1755. In the 10th edition of *Systema Naturae*, Linnaeus named this protozoan *Volvox chaos*. In a later edition, he changed the name to *Chaos protheus*. To anyone who has ever watched an amoeba under a microscope, the concept of chaos seems an appropriate basis for a genus or species name. In one of those endless disputes among taxonomists, there is some debate as to whether the original amoeba should be called *Volvox chaos* or *Chaos chaos*. Systematics aside, poetry would seem to dictate the latter name.

—*Harold J. Morowitz*, in *Entropy and the Magic Flute* (Oxford University Press)

Chaos theory is not as interesting as it sounds. How could it be?

—*Stephen H. Kellert*, in *In the Wake of Chaos: Unpredictable Order in Dynamical Systems* (University of Chicago Press)

Materials Physics

The Metal-Hydrogen System. Basic Bulk Properties. YUH FUKAI. Springer-Verlag, New York, 1993. x, 355 pp., illus. $98 or DM 138. Springer Series in Materials Science, 21.

Although materials have been under investigation for centuries, the discipline of materials science as we know it today was not born until the 1950s, following the invention of the transistor and other electronic devices through the application of the principles of solid state physics. Within a decade, researchers were attracted to challenging problems in metal-hydrogen systems—that is, materials consisting primarily of atoms of transition or rare-earth elemental

metals and hydrogen atoms. For physicists, the small mass of the hydrogen atom and its readily available isotope, deuterium, added to the inherent interest of these interstitially loaded metals, presenting exciting possibilities for the investigation of tunneling states, high-frequency phonon bands, high-mobility atoms, electronic structure, and large isotope effects. Physicists continue to find good problems to solve in these systems, from those with hydrogen-to-metal atom ratios as small as 1 to 1000 to those with nearly stoichiometric compound ratios of 2.00 or 3.00, in which the hydrogen-vacancy concentration may be as small as 1 per 1000.

Research in metal-hydrogen systems brought together scientists and engineers from physics, chemistry, and metallurgy who soon found that they had much to learn from each other. Although advances in the field are periodically reviewed, Yuh Fukai identified a need for a coherent description of the basic bulk properties of metal-hydrogen systems, with emphasis on the physics of how these properties come about. In *The Metal-Hydrogen System* Fukai identifies the key questions that we need to ask and keeps these questions before the reader as each individual topic is explored. The book contains an abundance of experimental results, and there are two-thirds as many figures as pages, but Fukai did not intend his volume to serve only as a source of data or a comprehensive guide to the literature (although over 800 references are listed). Rather, for each topic, experimental results are presented only as they relate to the development of our understanding of the underlying physics.

The book begins with coverage of phase diagrams and statistical thermodynamics of elemental and alloy metal-hydrogen systems. An entire chapter is devoted to the effects of high temperature and high pressure on these systems. The reader may at first be surprised that a significant part of this chapter treats the properties of solid hydrogen, including the high-pressure insulator-metal transition. But Fukai's motivation is clear when one views the entire phase diagram of a binary metal-hydrogen system over the full range of each element. Using tentative phase diagrams for systems at the hydrogen end, Fukai points out that recent progress in high-pressure technology may allow metallic hydrogen or liquid metal-hydrogen alloys to be approached via high temperatures and pressures. The discussion of the siting of hydrogen atoms in metals places considerable emphasis on the hydrogen wave function and its extent beyond one site or over a set of several adjacent sites. Theoretical calculations are compared with experimental results from inelastic neutron scattering.

Fukai manages to tie all the material together with greater coherence than might be achieved in a multiauthored volume. The discussion is progressively developed from one chapter to the next, with frequent cross-references. Lucidly written and mathematically accessible, this is a useful review of the physics of metal-hydrogen systems.

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Books Received

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